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Advances in parallel optimization for network structured problems have been applied to a variety of important real-world problems including military personnel readiness and portfolio optimization.

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UNIVERSITY OF CYPRUS

April 10, 1994

Dr Neal Glassman
Air Force Office of Scientific Research
Bolling Air Force Base
Washington, DC 20332-6448

Dear Dr Glassman:

I enclose the Final Report for AFOSR grant 91-0168 ~~91-0618~~. Please let me know if you need any further information from me at this time. All publications that cite the AFOSR grant were submitted to you with the Progress Reports in the past.

I would appreciate if you could let me know if this report satisfies the requirements of the AFOSR.

I believe that our research in parallel optimization methods for network-structured problems has advanced significantly the state-of-the-art in large scale optimization. It also had an impact on several applications we dealt with, such as problems of Naval personnel readiness and portfolio optimization. Eighteen (18) papers have been published in refereed Journals. I am now working on a textbook on the theory, algorithms and applications of parallel optimization.

I hope that we could collaborate further with your office in the future. I will get in touch with you once I return from my sabbatical.

With my greatest appreciation for your support during this project.

Sincerely yours,

Stavros A. Zenios

Stavros A. Zenios

cc: Office of Research Administration, University of Pennsylvania.

Please communicate with me preferably via FAX (357) 2-491685 at the University of Cyprus, or via email at zenios@wharton.upenn.edu.

AFOSR-TR- 94 0261

Final Report:
Parallel Decompositions
for Network Structured Problems

AFOSR grant 91-0168.

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April 1994.

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A. PUBLICATIONS IN PEER-REVIEWED PROFESSIONAL JOURNALS.

We list articles that have been published, or for which a letter of acceptance is available. Items [1, 15] are books; [15] was reviewed by anonymous referees solicited by Cambridge University Press, before the Press syndicate undertook its publication

References

[1] Yair Censor and Stavros A. Zenios. *Introduction to Methods of Parallel Optimization.* Colóquio 19^0 Brasileiro de Matemática, Instituto de Matematica Pura e Aplicada, Brazil, 1993, (280 pages), ISBN 85–244–0074–9.

[2] I. Krass, M. Pinar, T. Thompson, and S.A. Zenios. A large scale model for naval personnel readiness and its solution. *Management Science*, 1994. (to appear).

[3] X. Li and S.A. Zenios. Data-level parallel solution of min-cost network flow problems using ϵ-relaxations. *European Journal of Operational Research*, 1994. (in print).

[4] S. Nielsen and S.A. Zenios. Data structures for network algorithms on massively parallel architectures. *Parallel Computing*, 18:1033–1052, 1992.

[5] S.S. Nielsen and S.A. Zenios. Proximal minimizations with D-functions and the massively parallel solution of linear stochastic network programs. *International Journal of Supercomputing Appplications*, 1994, (to appear).

[6] S.S. Nielsen and S.A. Zenios. Massively parallel algorithms for nonlinear stochastic network problems. *Operations Research*, 41(2):1173–1193, 1993.

[7] S.S. Nielsen and S.A. Zenios. Proximal minimizations with D functions and the massively parallel solution of linear network programs. *Computational Optimization and Applications*, 1(4):375–398, 1993.

[8] M.C. Pinar and S.A. Zenios. Parallel decomposition of multicommodity network flows using linear-quadratic penalty functions. *ORSA Journal on Computing*, 4(3):235–249, 1992.

[9] M.C. Pinar and S.A. Zenios. On smoothing exact penalty functions for convex constrained optimization. *SIAM Journal on Optimization*, (to appear).

[10] M.C. Pinar and S.A. Zenios. A comparative study of parallel decompositions for multicommodity flow problems. *Parallel Algorithms and Applications*, 1:255–271, 1993.

[11] M.C. Pinar and S.A. Zenios. Data-level parallel linear-quadratic penalty algorithm for multicommodity network flows. *ACM Transactions on Mathematical Software*, 1994, (to appear).

[12] S.A. Zenios. On the fine-grain decomposition of multicommodity transportation problems. *SIAM Journal on Optimization*, 1(4):643–669, 1991.

[13] S.A. Zenios. Data parallel computing for network-structured optimization problems. *Computational Optimization and Applications*, 3:199–242, 1994.

[14] S.A. Zenios. A model for portfolio management with mortgage-backed securities. *Annals of Operations Research*, 43:337–356, 1993.

[15] S.A. Zenios, editor. *Financial Optimization*. Cambridge University Press, 1993, ISBN 0-521-41905-0.

[16] S.A. Zenios. Parallel and super-computing in the practice of management science. *Interfaces*, 1994. (in print).

[17] S.A. Zenios and Y. Censor. Massively parallel row-action algorithms for some nonlinear transportation problems. *SIAM Journal on Optimization*, 1(3):373 400, 1991.

[18] S.A. Zenios and M.C. Pinar. Parallel block-partitioning of truncated Newton for nonlinear network optimization. *SIAM Journal on Scientific and Statistical Computing*, 13(5):1173–1193, 1992.

[19] S.A. Zenios, M.C. Pinar, and R.S. Dembo. A smooth penalty function algorithm for network-structured problems. *European Journal of Operational Research*, 78:1–17, 1994.

[20] S.A. Zenios and M. S. Shtilman. Constructing optimal samples from a binomial lattice. *Journal of Information and Optimization Sciences*, 14(2):1–23, 1993.

D. ADDITIONAL RESEARCHERS WORKING WITH THE PI.

The following received partial funding from the AFOSR grant, or collaborated with the PI:

1. Dafeng Yang, PhD student, University of Pennsylvania, 1992–today.
2. Raymond McKendall, Post-doctoral student, University of Pennsylvania, 1991–1993.
3. Michael Shtilman, partially funded as a Research Associate, 1991.
4. Pan Kang, partially funded as a Research Associate, 1990–1992.
5. Soren Nielsen, received his PhD in 1992, currently with the faculty at University of Texas at Austin
6. Mustafa Pinar, received his PhD in 1992, currently a Research Associate with the Technical University of Denmark.
7. Alex Meeraus, GAMS Development Corporation, collaborated with the PI without funding.

8. Henrik Dahl, GAMS Development Corporation. collaborated with the PI without funding.

9. Martin Holmer, The Federal National Mortgage Association, Washington. DC. collaborated with the PI without funding.

C. PROFESSIONAL HONORS.

1. Second Prize, Gordon Bell Competition, 1988. IEEE Competition on Parallel Computing

2. Member of the editorial boards for: *SIAM Journal on Optimization* (since 1991), *ORSA Journal on Computing* (since 1987), *Naval Research Logistics* (since 1989), *Computational Optimization and Applications* (since 1991), *Parallel Algorithms and Applications* (since 1992).

3. Full member, *Operations Research Society of America* (since 1990).